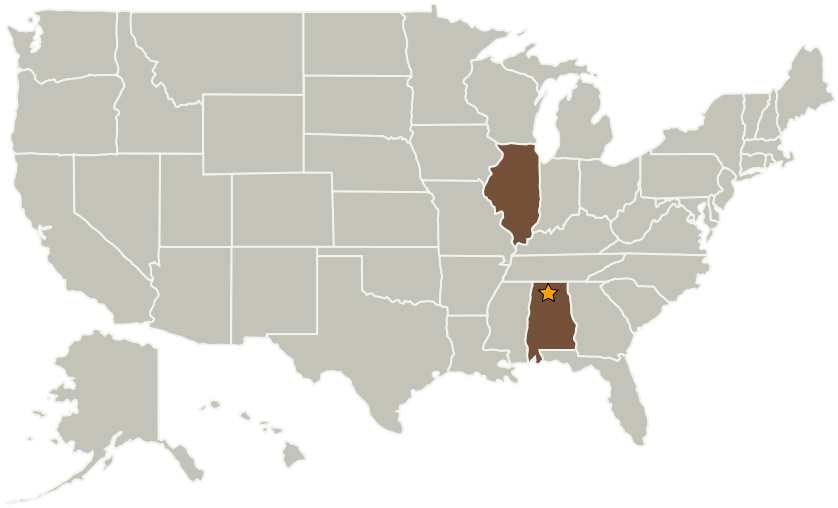
Multi-Phase Flow Analysis Tools for Solid Motor Applications, Phase II

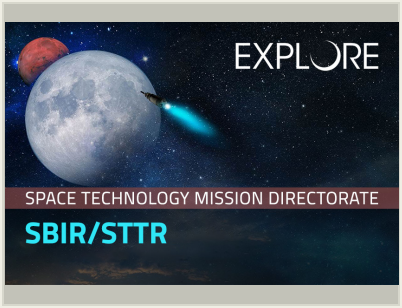
Completed Technology Project (2009 - 2011)

Project Introduction

The challenges of designing, developing, and fielding man-rated propulsion systems continue to increase as NASA's Vision for Space Exploration Program moves beyond the Space Shuttle and RSRM. The number and type of different propulsion elements required are significant, and predicting internal solid motor behavior and characteristics and assessing external environments (e.g., plume impingement on vehicle structures and launch acoustic loading) is a priority. Our proposed innovation will enhance existing engineering software by combining new physical modeling capabilities with appropriate boundary conditions to create a novel toolset for complex multi-phase solid rocket analyses. The innovation will be based on the Loci/Chem multi-physics analysis package and will utilize new Loci features, new multi-phase flow models, theoretical and phenomenological boundary conditions, and modified real gas equations of state to create a unique software tool for particle breakup, surface heat transfer with particle deposition, launch environment characterization, and nozzle erosion for next generation solid motors. Our research products will provide NASA with the important capability to simultaneously analyze solid propellant combustion, heat transfer, launch acoustics, and nozzle erosion within a single unified numerical framework. We will validate the approach using appropriate two phase flow problems to achieve a TRL range of 3-4.

Primary U.S. Work Locations and Key Partners





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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★Marshall Space Flight Center(MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
Tetra Research Corporation	Supporting Organization	Industry Women-Owned Small Business (WOSB)	Princeton, Illinois

Primary U.S. Work Locations	
Alabama	Illinois

Project Transitions

June 2009: Project Start

June 2011: Closed out

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.4 Solids